RAILWAY ENGINEERING

AND MAINTENANCE OF WAY

Vol. V JUNE, 1909 No. 6

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Railway Engineering

and Maintenance of Way

Mr. F. E. Fox, master mechanic of the Denver & Rio Grande, at Denver, Colo., has resigned.

Mr. J. G. Kirby has been appointed assistant general foreman of the Locomotive department shops of the New York Central & Hudson River at Avis, Pa.

Mr. Sheridan P. Jordan has been appointed roadmaster of the Sandusky division of the Lake Shore & Michigan Southern, with office at Sandusky, Ohio, succeeding Mr. C. Buhrer, resigned on account of ill health.

Mr. J. H. Conlan, general roadmaster of the Trinity & Brazos Valley, has resigned to engage in other business.

Mr. E. E. Pettibone has been appointed land department engineer of the New York Central, with headquarters at Chicago, Ill.

Mr. W. M. Netherland, general storekeeper of the Southern, has in addition to his former duties been appointed general storekeeper of the St. Louis-Louisville lines.

Mr. John Kent of North Tonawanda, N. Y., has been appointed inspector of the newly installed automatic electric signal system of the New York Central on the Buffalo division. Mr. George Bigger succeeds him as electrician at North Tonawanda.

Mr. R. L. Butler, master mechanic for Missouri Pacific at Atchison, Kan., has been transferred to the shops of the St. Louis, Iron Mountain & Southern at Ferriday, La., vice Mr. W. S. Kenyon, transferred to the shops of same road at McGehee, Ark.

Several important changes have been made in the engineering department of the Baltimore & Ohio on account of the death of Chief Engineer D. D. Carothers some time ago. In addition to the promotion of Mr. A. M. Kinsman from engineer of construction to chief engineer to suceed Mr. Carothers, Mr. Paul Didier, of Pittsburg, has been promoted from district engineer to principal chief assistant engineer, and Mr. William C. Hart has been appointed assistant to the chief engineer.

Mr. John J. Ellis, who retired from the position of superintendent of motive power of the Chicago, St. Paul, Minneapolis & Omaha on Jan. 15, was presented with a handsome silver loving cup on April 18 by the employes of the motive power and mechanical departments of that road. The loving cup presented Mr. Ellis is of solid silver and stands fully two feet high and is inscribed: "Presented to John J. Ellis by the employes of the motive power and mechanical departments of the Chicago, St Paul, Minneapolis & Omaha Railway as a token of our love and respect."

Mr. A. H. Gairns, division master mechanic of the Oregon Short Line, with office at Pocatello, Idaho, has been appointed master mechanic of the Idaho division only, with office at Pocatello. Mr. H. Carrick, assistant division master mechanic at Pocatello, has been appointed master mechanic of the Montana division, with office at Pocatello. Mr. George Ross, district foreman at Salt Lake City, Utah, has been appointed master mechanic of the Utah division, with office at Salt Lake City, and the office formerly held by him has been abolished.

Mr. F. B. McCutcheon, chief engineer of the Gulf & Ship Island, has resigned and his former office has been abolished. Mr. W. T. Stewart has been appointed superintendent of roadway and will have charge of maintenance of way, bridges and buildings.

Mr. A. Stewart, general superintendent of motive power and equipment of the Southern Railway, with office at Washington, D. C., has been appointed also general superintendent of motive power and equipment of the St. Louis-Louisville Lines of the Southern Railway, with office at Washington.

Mr. D. W. Lum, engineer of maintenance of way and structures of the Southern Railway, with office at Washington, D. C., has been appointed also the chief engineer of maintenance of way and structures of the St. Louis-Louisville Lines of the Southern Railway, with office at Washington.

Mr. H. A. Genung has been appointed engineer in charge of maintenance of way, bridges, buildings and water service on the San Antonio division of the International & Great Northern, with office at San Antonio, reporting direct to the general manager. Mr. O. H. Crittenden, chief engineer, is relieved of active duties on this division, except as Consulting Engineer.

Mr. A. H. Gairns, division master mechanic of the Oregon Short Line, with office at Pocatello, Idaho, has been appointed master mechanic of the Idaho division only, with office at Pocatello. Mr. H. Carrick, assistant division master mechanic at Pocatello, has been appointed master mechanic of the Montana division, with office at Pocatello. Mr. George Ross, district foreman at Salt Lake City, Utah, has been appointed master mechanic of the Utah division, with office at Salt Lake City, and the office of district foreman has been abolished. The office of traveling engineer, formerly held by Mr. Peter Sorensen, has been abolished.

Mr. J. H. Davis, assistant electrical engineer of the Baltimore & Ohio, has been appointed the electrical engineer, with office at Baltimore, Md., succeeding Mr. L. T. Gibbs, deceased. Mr. Davis studied both civil and electrical engineering at the University of Arkansas, receiving the degree of Electrical Engineer in 1897. He then became associated with the St. Francis Levee Board doing dike and levee work along the Mississippi in the neighborhood of Memphis, Tenn., under the supervision of the United States Army. In 1901 he became connected with the electrical department of the Pennsylvania and in 1905 was appointed assistant electrical engineer of the Baltimore & Ohio.

Mr. H. E. Warrington, chief engineer of the Cincinnati, New Orleans & Texas Pacific and the Alabama Great Southern, has resigned and the office abolished. Mr. Curtis Dougherty has been appointed engineer of maintenance of way of both of the roads, with office at Cincinnati, Ohio, and Mr. B. Herman, engineer of bridges, with office at Cincinnati, Ohio.

Mr. E. Fischer, formerly engineer of bridges and buildings of the Missouri Pacific, has been appointed resident engineer of the St. Louis, Brownsville & Mexico at Brownsville, Tex. Mr. Fischer will take charge of the construction of the bridge over the Denver & Rio Grande, which is being built jointly by the St. Louis, Brownsville & Mexico and the Mexican National.

Mr. Howard R. Pratt, engineer of maintenance of way of the Western Maryland, has been appointed chief engineer of that road.

Mr. T. H. Kruttschnitt, son of Julius Kruttschnitt, vice-president and director of maintenance and operation of the Harriman system, has been appointed assistant roadmaster on the Shasta division of the Southern Pacific at Weed, Cal.

Mr. C. P. Purdon has been appointed chief engineer of the Memphis Railroad Terminal Co., to succeed W. H. Harrison, who has resigned.

Mr. W. G. Seibert has been appointed master mechanic of the Missouri Pacific at Fort Scott, Kan., succeeding Mr. T. F. Carberry, assigned to other duties.

Locomotive Repair Shops, Battle Creek, Mich.

Grand Trunk Railway

These shops are centrally located on the Western Division, and take care of the repair work for 259 locomotives, covering over 1,000 miles of track. The general layout provides for a future extension of 100 per cent to each building in such a manner that the area for extension is not between the structures, in which case it would be necessary to carry material from different departments over this additional area. Provision has also been made on the top site of the car department, which is to be located east of the present buildings.

The power house is located at the east side of the shops so as to be central when the car shops are erected. The 75-ft., 10-ton yard crane serves all shops and storehouse, covering an area of 100,000 sq. ft., which its used for the storage of heavy material, castings, etc. A foundry, and carpenter and pattern shops, are to be located on the north side of the yard crane runway opposite the locomotive shops, and the frog shop just east of the present forge shop, on the south side of the yard crane runway.

All buildings are parallel to the main line, and all yard tracks to buildings, connect with the main line to give free movements of material to and from the shops.

The power house is a handsome substantial building, the concrete foundation of which rises to a height of 5 ft. above the ground, and supports the steel structure with its colonial shale brick walls and flat composite roof of asphaltum. The floors throughout the building are of concrete, thus minimizing the danger of fire. The two parts, into which the building is divided, form suitable boiler and engine rooms.

The boiler equipment consists of four vertical Wickes boilers each of 340-h. p., a water heater 54 ins. in diameter and 23 ft. high, and an outside packed Union boiler feed pump. The boilers, which are arranged in batteries of two, each battery occupying 596 sq. ft., are hand fired with a heating surface of 3,402 sq. ft. and are supplied with rocking grates 52 sq. ft. in area. Coal is dumped into the bunker directly from the cars and led into the coal chutes, which are conveniently arranged before each firebox, the labor of stoking being thus reduced to a minimum. More than sufficient draft is obtained from a circular concrete chimney which rises to a height of 175 ft., and is so constructed as to permit the extension of the boiler plant if an increase of power is desired. High pressure steam is supplied to the engine room for power; to the forge shop to operate the steam hammers; to the locomotive shops to drive the heating fans and for boiler testing purposes; and to the office and storehouse where it is reduced in pressure and used for heating purposes. Low pressure exhaust steam and, when this is insufficient, steam reduced from high pressure is used to heat the locomotive and forge shops. The steam piping leading to the different buildings is suspended in an underground concrete tunnel, covered with movable concrete slabs which, being slightly above the level of the surface of the yard, form a convenient walk down the midway.

In connection with the water system there is a water storage tank of 100,000 gallons capacity, supported on a steel structure 120 ft. high. This tank is supplied from the shop mains. The water pipes pass through the power house and the piping and valves are so arranged that the shops can be supplied either from this tank, or from the city mains, and that water can be pumped by a fire pump into the tank, or from either tank or city mains into the shop water system. This pump is a Worthington fire pump with a capacity of 1,000 gallons a minute and capable of maintaining a pressure of 75 lbs. There is also a vacuum pump connected in the return from the heating system which reduces the pressure in the return pipes to the equivalent of 10 ins. of vacuum. These two pumps and an oil filter are placed in the engine room on the floor below the level of the main room, which is 5 ft. above the ground.

In regard to electric power, after careful consideration, it was decided that it could be purchased more economically than generated. Power is therefore obtained from a hydro-electric plant which delivers it over a 3-phase, 60-cycle, 5,000-volt alternating current transmis-

Interior View of Erecting Shop, Grand Trunk Ry., Battle Creek, Mich.

sion line provided on entering the power-house, with the necessary protection against lightning. In the shops direct current of 220 volts, and alternating current at 440 volts are called for. To meet the requirements there are two banks of transformers in the power house, one composed of three single-phase, 250-kw. transformers by means of which the voltage is stepped down from 5,000 to the 440 volts necessary; the other consists of three single-phase 75-kw. transformers, the secondary voltage being 152, the necessary voltage a 250-kw. rotary converter providing the desired 220-volt direct current. A small induction motor is used to bring this converter up to synchronous speed. In addition a 200-kw., 440-volt, 60-cycle, 3-phase generator, driven by a 300-h. p. simple noncondensing Corliss engine, running 150 revolutions per minute, installed, as well as a generator exciter driven by a small vertical steam engine. This generator can be used to avoid complete shut-down in case of trouble with the transmission line or generating plant. Also, as more exhaust steam than can be obtained from the fan engines and steam hammers is required for heating purposes in cold weather, it is clear profit to first utilize the live steam in driving the generator and exhaust from the engines for heating. The electrical apparatus in the powerhouse was manufactured by the Westinghouse Electrical Manufacturing Company.

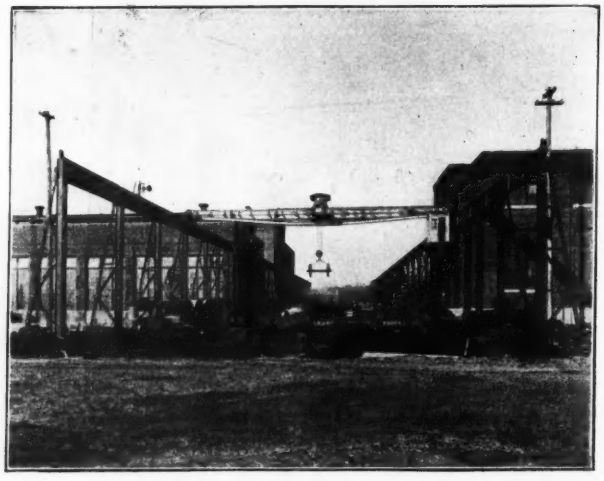
The high tension apparatus, which can be operated from the switchboard by means of remote central switches, is located on two balconies, one above the other beneath which the transformers are situated. In front of these, and facing the balconies is the switchboard, before which are located the generator, exciter and converter. Connected with the switchboard are two sets of alternating current, bus cars carrying 440 volts, one for generator, the other for the purchased power, and also the buses for the 250-volt direct current circuit. The switchboard comprises the necessary panels for the control of the convertor, and of the direct current, alternating current, generator, and purchased power lines, as well as six alternating current and two direct current feeders, the alternating current feeders are so connected that they can be thrown on either the generator or the purchased power buses.

A tunnel, built of concrete, lies beneath the floor behind the switchboard and passing through this the feeders are carried in lead-covered cables through clay conduits from the power house to the fuse panels in the shops. Branches to motors and lighting circuits are connected to the feeders in service boxes.

ERECTING AND MACHINE SHOP.

The erecting and machine shop is a spacious building, under one roof, and constructed of steel, concrete and brick, being of self-supporting type, having floor dimensions of 170x612 ft.

The concrete portion of the walls rises to the level of the window sills, from which point to the roof brick is employed, colonial shale being used on the outside. The roof covering is a composition of felt and tar spread over with gravel, light being obtained through skylights and surrounding windows of the erecting shop, while the roof lighting of the machine shop is furnished through windows of saw-tooth type.



Yard Crane Runway, Battle Creek, Mich.

By the medium of four pipes, placed at 24 ft. intervals connected to drain pipes inside the building, water from the roof is conducted to the sewer.

Particular attention has been devoted to obtain full benefit of natural light. Instead of the ordinary window glass, the corrugated style was adopted, which latter though not clear enough to distinguish objects through, nevertheless produces the effect, giving a better diffusion of light and almost entirely eliminating shadows. Besides this the interior of the building, being painted white, produces an excellent reflecting surface.

Due consideration regarding the comfort of the employes is quite apparent in these shops. Situated on the balcony which extends along the machine shop side of the wall, a length of 588 ft. by 40 ft. in width, are to be found three heating fans by means of which air is drawn over an aggregate of 43,500 lineal feet of 1-in. steam pipe coils. The heated air passing through down ducts enters concrete tunnels, leading to the different users along the walls, slightly above floor level, from whence it enters the shop. It can be readily imagined that by this method, besides imparting warmth, a perfect circulation of air is steadily maintained.

A 60 h. p. engine drives each of these fans, the exhaust steam passing through the coils, which steam, along with that from the steam hammers, pumps and main engine, is ample to cope with an outside temperature considerably below zero point.

There are also located on the balcony, toilet rooms, and lavatories of approved sanitary design, a copious supply of hot and cold water being on hand at all times. Individual lockers of the hospital type are placed along the walls of the lavatories and in one of these each employe hangs his hat and coat during working hours.

Five feet metal urinals, which are also sanitary in design, are located on the ground floor at the column, on the dividing line between erecting and machine bays.

Hemlock sleepers placed four feet apart in well tamped sand constitute the foundation for the ground floor which is of 3x6 in. yellow pine.

In the erecting bay which is 70 ft. wide by 612 ft. long are twenty-five engine pits, each 43 ft. in length, having a space allowance of 24 ft. between their respective centers.

Extending along the side of each pit are recesses, in which are hung air piping and wiring conduits. The latter have connections to admit of the use of extension incandescent lamps. Water and steam pipe valves are placed at the back end of each pit to be used in connection with the customary boiler test. Between each two pits is located a work bench attached to which are two extension lamps simlar to those in pits. Each of the benches is also equipped with two heavy vises. To all the supporting columns adjacent to the back end of the pit, there are also attached air pipe connections, and plug receptacles.

The erecting bay possesses the advantage of two electric cranes, one of 120-ton and the other of 10-ton capacity. These are supported by separate runways, which are attached to the steel frames of the building. The larger crane being above the smaller one has ample headroom to carry a locomotive the entire length of the shops over the others, while the smaller crane expedites the work of stripping and erecting various parts of the engines.

Motor driven double emery wheels are placed along the walls immediately in front of the locomotives to save time on various portions of the work.

There are two tracks which enter the machine shop opposite the sixth pit from each of the erecting shops to facilitate the transporting of engines to and from that shop.

At one end of the erecting bay five pits are temporarily covered over, that portion being allotted to the pipe department and also to the welding and cutting of flues. It might be stated that due to the fact of an approved method of repairing flues and also the relative location of each machine and furnace, the process of accomplishing the work is of an expeditious character. A motor driven pressure blower delivers a 14 oz. blast to both of these last named departments.

Running parallel with the erecting bay is located the

Norton Draw-Cut Planer, Battle Creek, Mich.

heavy machine tool section of the machine shop. This section is 60 ft. in width and 612 ft. long. It is not at present used entirely in the interest of the machine shop, about 120 ft. being used as carpenter shop. The entire length, however, is served with a 10-ton crane. The machines in this section are driven by an individual motor. With the exception of a portion of the wheel and truck department and the major portion of the general machine department, all the other departments embraced within the machine shop on the ground floor are arranged under the balcony in the following order, commencing 24 ft. from the west end: Wheel and truck, piston and crosshead, motion, tool, bolt and rod. The tin, paint, air brake, brass finishing, machine repair, belt and electrical departments are located on the balcony floor which is of re-inforced concrete.

In order that each one of the above named departments might be self-sustained a sufficient number of machines of varied types have been allotted it thus obviating the frequent handling of the work.

A concrete caustic soda vat having inside dimensions of 10x10x10 ft. deep is located in the main bay of the machine shop. By means of this the work of cleaning wheels, engine trucks, etc., is quickly accomplished. Through the medium of a small motor driven exhaust fan the fumes from this vat are conducted outside the building.

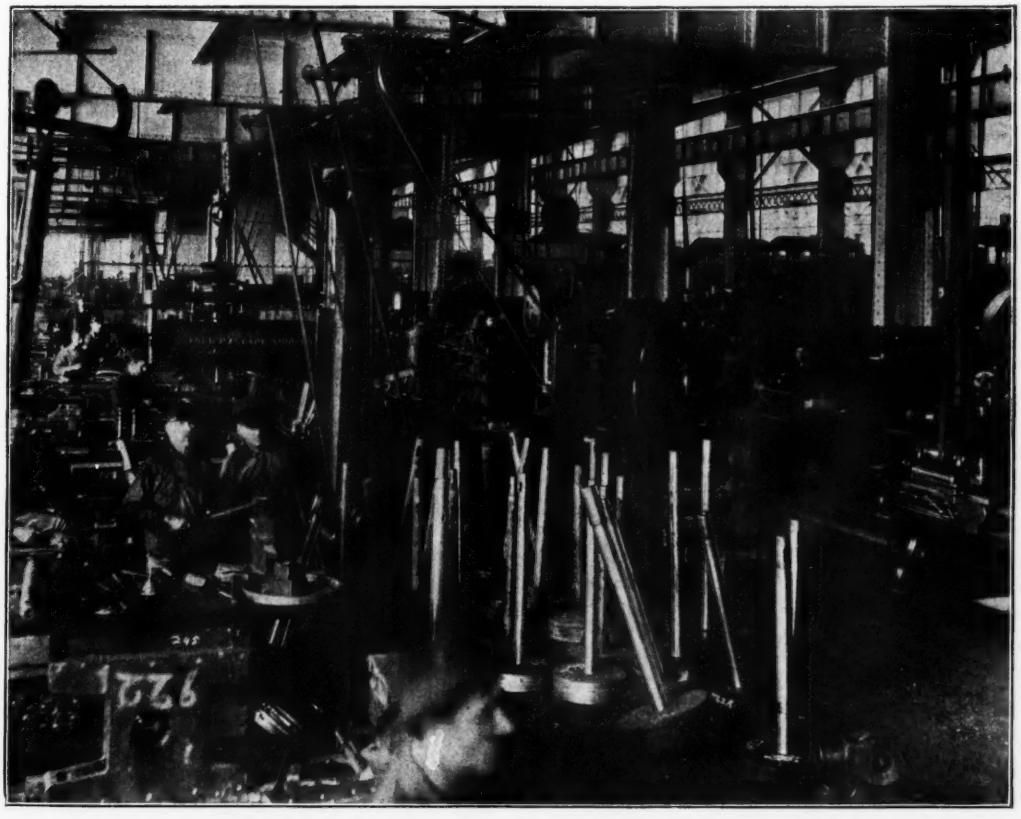
BOILER AND TANK SHOP.

These shops are located at one end of the machine and erecting shops at right angle thereto, being constructed on similar lines to that of the erecting shop, having floor dimensions of 180x205 ft. A brick curtain separates this shop from the erecting and machine shops. An opening, however, admits of the conveying of boilers to and from the erecting shop, the boilers being passed through by means of a truck with a revolving top.

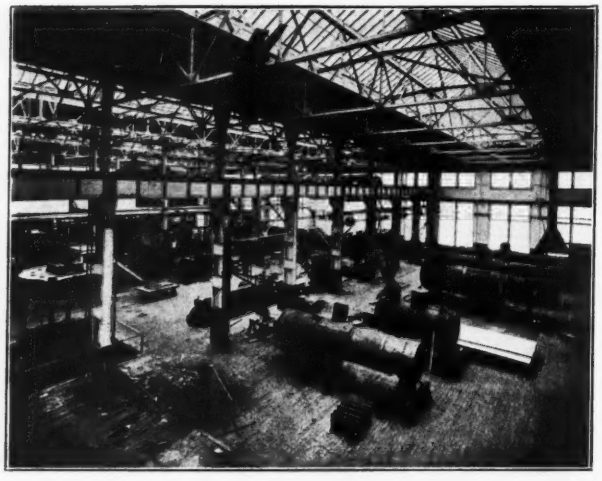
The main boiler bay is 60x180 ft. and has ample capacity to accommodate nine boilers at one time and is covered by a 30-ton double trolley crane. In the machinery bay which has dimensions of 50x180 ft., an accumulator capable of exerting water pressure of 1,500 lbs. per sq. in. has been installed. This is supplied by two motor driven pumps adjacent to it. The hydraulic tools consist of a large four-post flanger and a horizontal punch having a 60-in. throat. In addition to these there is in the forge shop two heavy shears, a large punch and a bulldozer, which receive power from this plant. The riveting tower has not yet been equipped with its relative machinery.

A large annealing furnace forms a part of the equipment in this department, also a motor driven splitting shears and punch, besides other miscellaneous tools. The brass foundry is also temporarily located in this bay. A 10-ton overhead travelling crane and several jib cranes facilitate the handling of the work in this bay .

The tank shop is divided into two bays running parallel with each other; one on which truck wheels and axles are dealt with and the other dealing with repairs to frames and tanks, the tank bay having a floor space of 65x205 ft., which gives ample room to place a tank and



Light Machine Bay, Grand Trunk Ry., Battle Creek, Mich.



Boiler Shop, Battle Creek, Mich.

a frame on a single stall. A 20-ton double trolley crane is employed in this bay.

Alluding again to the machine bay which has a floor space of 30x205 ft., half of this bay is traversed by a five-ton single trolley crane, the remaining portion having been provided with a balcony on which are located toilet rooms and lavatories, containing indivdual lockers. In addition to this there is a blower of which the heating coils contain 15.50 lineal feet of 1-in. pipe. Thus the building is kept at a comfortable temperature even in the coldest weather.

On each column in this building there are air drops and lighting receptacles similar to those described in the machine and erecting shops. In the locomotive, boiler, and tank shops, offices for the foreman have been provided. These are equipped with telephones and are elevated above the ground floor, thus commanding an unobstructed view of the entire shop.

Throughout each building and attached to their supporting columns are to be found fire hose supports, on which are hung the necessary fire hose, which are also connected to their respective water valves. By means of this arrangement there exists excellent fire protection.

FORGE SHOP.

The forge shop is 66 ft. east of machine and erecting shop with the north end on yard crane runway. The building is a self-supported steel-frame with brick curtain walls, composition roof and cinder floor. The inside dimensions are 100x200 ft. and 24 ft. 8 ins. from floor to bottom of roof trusses.

The building is divided into ten 20-ft. bays. The windows are 15 ft. 8 ins. wide, and extend from concrete water table to bottom of roof trusses. The center of roof has a monitor 10 ft. high by 20 ft. wide with a pivoted sash, mechanically operated for ventilation and light, and this with wall windows gives excellent lighting.

Ribbed glass is used, which diffuses the direct rays of the sun, so that men working close to the windows are not inconvenienced when the sun shines directly on sides of building. The toilet and locker rooms are located on the outside on the west side of building.

All steam piping is carried in an underground tunnel in center of building to and from steam hammers. The oil and water piping is carried underground in pipes laid in concrete and high pressure air in roof trusses with outlets on columns. The wiring is brought in at north end of building and carried overhead for lights and motors.

All material in this shop is handled by jib cranes and cars on a 24-in. industrial track and serves all parts of the building. The coal and coke sheds are located just south of shops, and industrial track runs into it, so that coal can be taken to all forges on a small coal car.

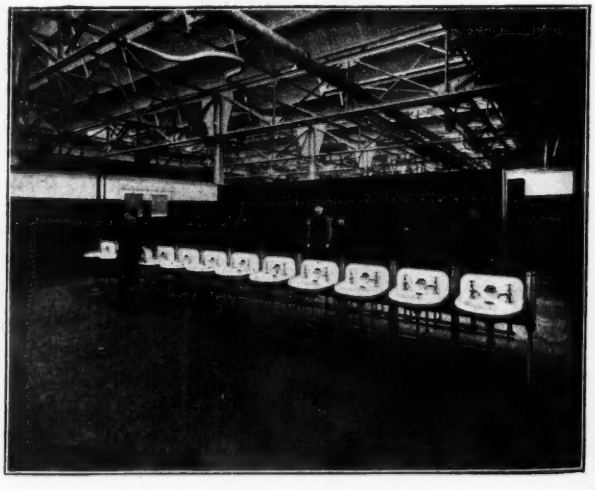
The draft for all furnaces and forges is furnished by the American Blower Co.'s blower, directly connected to a 100-h. p. induction motor. The air piping is galvanized and is carried overhead for forges and furnaces, except where the down spout would interfere with jib cranes, in which case it brought down the wall, and underground to furnace or forge.

There are 10 McGaslin double forges on the west side of building. All light work is done on the side next to wall, while on the side next to the steam hammers which range from 350 lbs. to 3,300 lbs., the heavy work is taken care of. Near the north end of the forges in the center of the building is placed a special fire, which is raised and lowered by air. This is used for welding frames and is close to the 3,300-lb. single frame hammer, both of which are covered by a jib crane and are close to yard crane for handling engine frames.

The hydraulic bulldozer, the hydraulic bar sheer, 3½-in. forging machine, 1½-in. bolt forging machine, with their oil furnaces, are located in northeast corner of shop and take care of all machine forging for the plant.

Just south of them on east side of building is the axle department, with axle furnace, 5,000-lb. hammer and double cut-off and centering machine. This machine and the two forging machines are run by a 30 h. p. motor group drive. The 3,500-lb. hammer and furnace are located just south of this, and take care of the heavy forge work.

The spring department is located in the south end of



Lavatories, Battle Creek, Mich.

Tank Shop, Grand Trunk Ry., Battle Creek, Mich.

the shop, and contains the nibber and trimmer, and tapering rolls, with individual motors, also a hydraulic punch and hydraulic spring bender, with suitable furnaces conveniently located. There is a vertical hydraulic shear near the center of the shop for general purposes.

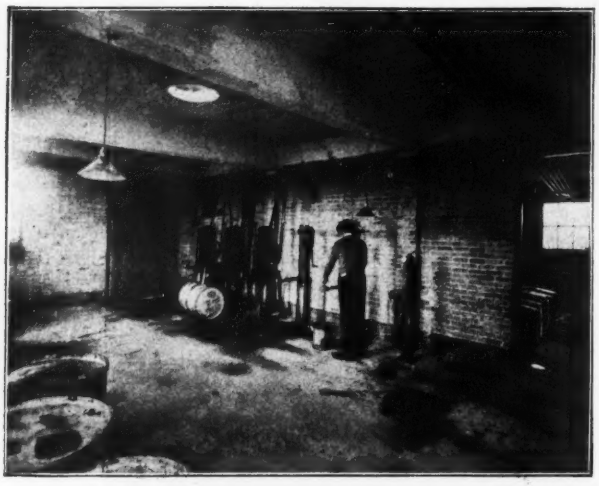
All furnaces are of oil burning type, supplied from tanks located in a concrete oil house about 300 ft. south of forge shop under a pressure of 20 lbs. All forges are fitted with 22-ft. stacks extending through the roof, thus removing the smoke and gases by means of natural draft.

STORE, OFFICE BUILDING AND OIL HOUSE.

The store and office building is a two-story structure, built of re-inforced concrete and brick. It is 60 ft. wide by 200 ft. On the east and west sides there is a concrete platform 12 ft. wide. This platform is on a level with the first floor, which is occupied by the store department and the unloading tracks which run on either side of the building are located at a level convenient for unloading freight from the cars to the platform. These platforms extend to the center of the midway where heavy material may be easily handled with the yard crane. The platform along the east side extends to and around the oil house, which is located about 150 ft. from the store and office building.

The main entrance to the building is located in the south end. At this point there is a spacious hallway; to the right is the clerk's office of the store department, to the left the storekeeper's private office, while directly in front is a stairway leading to the motive power department offices which occupy the second floor. Back of the stairway on the first floor is located the vault, filing and toilet rooms and then comes the general store room which is fitted up with necessary shelving counters, scales, etc., and is very complete in detail.

The second story is occupied by the master mechanic and his staff, it is divided into two sections by a hallway running from the top of the stairway to the assembly rooms at the north end. The master mechanic's private office which is located at the southwest corner in a commodious room 20 ft. square finished in quartered oak, maple floor and tinted walls. Next to this in the south end is the stenographer's office, 14x20 ft., and on the west side the clerks' room, 32x50 ft.. adjacent to the clerks' room is the filing room and vaults. Continuing along the west side the drawing class room is next and this room is 32x40 ft. It is fitted with tables, drawing boards, blackboards, etc., and across one end is a row of clothes lockers to accommodate the clothing of those who attend the evening classes Two evenings a week are devoted to the instructing of apprentices in mechanical drawing, practical mechanics and electricity. Across the hallway from the drawing class room is a reading room 20x40 ft. This room is provided with the latest periodicals pertaining to the mechanical, scientific and literary world. Leading from this room and also the drawing class room are vertical rolling doors, which may be opened into the assembly room, which is 60x80 ft. and will accommodate about 400 persons easily, making an ideal place for social functions, lectures, etc. Continuing along the east side and opening from the reading room is the library with the book cases which are stocked with the latest work of fiction. The toilet room comes next, followed by the drafting room in the southeast corner.



Oil House, Battle Creek, Mich.

The building is lighted throughout by incandescent electric lamps of 16 candlepower. Clusters are artistically arranged on chandeliers hung from the ceiling, each lamp being inclosed in frosted glass globes. In the office where desk work is being carried on, plug connections are arranged at convenient places in the walls so that desk lamps may be used. Steam heat is used throughout the building, the steam being supplied from the power house at low pressure.

The part of the building devoted to the office work is finished in quartered oak, maple floor over concrete, and tinted walls. Class partitions are located on either side of the wall, on upper story. Each room is provided with necessary lockers and toilet.

The oil house is a single story building 30x40 ft. and it is built of re-inforced concrete and brick. The floor of the building is about ten feet above the ground level, which happens to be low at this point and makes convenient place for the air storage tanks, ten in number, with a capacity of 2,000 gallons each. The oil house is divided into two rooms of equal size, one is used as a pump room for pumping the air from the tank below, the other for the storing of oil in barrels. The oil pumps are six in number, three of which are power pumps and the others are operated by hand. These are of the Bowser self-measuring type. The power pumps are operated by a two-horsepower Western Electric motor, belted to line shaft.

SEWERAGE.

It was necessary to install two sewer systems, as it is against the rules of the City Board of Health to dump raw sanitary sewerage into the creek at this point because it would become a nuisance in the summer when water is low as the creek flows through the center of the city for two miles.

It was either a case of putting in a purification plant or pump 1,000 ft. against a head of 25 ft. into the city sewer. There is such a small difference in elevation between end of sewer and creek which is close by that filtration beds would be overflowed several times every year by the high water in the creek, therefore it was decided to install the pumping plant. The pump pit house is located south of buildings and all sanitary sewerage is brought to this point by gravity.

The pumping apparatus consists of two separate units so that one is always ready in case anything goes wrong with the other. Each one has centrifugal pump directly connected to a vertical motor which is controlled by a switch and when water reaches the required height in pit, one pump then starts up and pumps it out, and if this pump does not work, the other pump will start when it get a few inches higher, and pump it out.

All rain water and water used for washing out engines, cooling compressors, etc., is carried by the storm sewer into the creek by gravity. The sewers are built of extra heavy double strength sewer tile with self-cleaning grades outside of building, and inside of buildings. All sewers are of cast iron soil pipe to a point 4 ft. outside of building. All closets, lavatories and urinals are of white heavy enameled iron with a hardwood finish.

TELEPHONE SYSTEM.

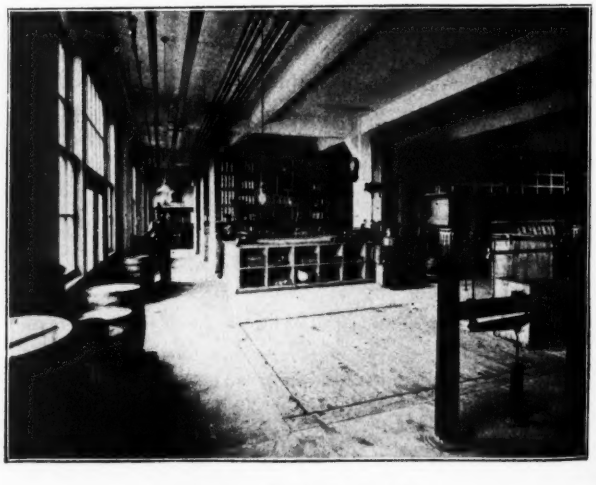
A local telephone system, connecting all foremen's offices, petit stores, powerhouses and other departments, has been installed. The switchboard is located in the general office of the master mechanic. At present 14 telephones are used and provision has been made on switchboard for a total of 25 telephones, which will be installed when foundry, frog shop, carpenter shop and car department are added to the present plant.

WATCHMAN'S SYSTEM.

A watchman is kept on duty at plant both day and night. There are fourteen stations located around the plant at different places. Newman clock is used and the night watchman having to visit each station once every hour from 6 p. m. to 6 a. m. and register the stations on clock which shows on its record sheet the exact time each station was visited during the night.

THE REGISTRATION.

Each workman is required to punch a time clock on entering the shop in the morning, when leaving and returning at noon, and when leaving in the evening. Eight-day time registering clocks are used for this purpose. They are distributed in such a manner that they are convenient



Storehouse, Battle Creek, Mich.

Air Brake Department, Grand Trunk Ry., Battle Creek, Mich.

for workman to punch without extra walking from his entrance to building.

MOTORS.

The alternating circuit motor is used in all cases, except where speed variations cannot be mechanically accomplished, in which case direct current motors are employed. All motors from 5 h. p. and over are equipped with suitable starting devices, fuses and circuit breakers with low voltage release.

LIGHTING.

The general shop lighting is obtained by Copper Hewitt mercury lamps, which give a very steady and efficient light. They use a set of balanced coils, star connected to the 400-volt shop feeders. This gives a voltage between the neutral wire and any phase of 256 volts, which operates them. They are self-starting and light up as soon as switch is turned without tilting the tubes. They are connected two in multiple for each switch.

The installation here is interesting because this is about the first large shop in the country to install the alternating current type of Cooper-Hewitt lamp. The incandescent lights for drop lights in engine pits and erecting bay, also foreman's offices, are tapped directly off the 250-volt direct-current feeders. The lights for offices and store house are incandescent, and use transformers to step down from 440 volt to 110 volt. The yard lighting is done with series arc lights. A special panel and constant current transformer is located in power house for these, as the switchboard attendant turns them off and on.

WATER SYSTEM.

Water is pumped from the river at Nichols roundhouse, and forced through a 6-in. main to the repair shops. There is also a connection on the ground to the 2-in. high pressure main of the city water department that can be used in case of emergency. The water from the power house is carried through a loop of 2-in. mains around the shops to fire hydrants and different points along the buildings, from which points it is conveyed through the buildings in underground cast-iron pipes .

Drinking water is supplied from a deep well at power house, and is pumped through galvanized pipe to the different drinking fountains in shop by a small pump in power house.

COMPRESSED AIR.

The compressed air system is rather a novel departure from the usual practice, as a number of units distributed over the shops are used instead of a centrally located one. There are three 100 h. p. Ingersoll Rand air compressors, directly connected to 106 h. p. Western Electric induction motors, having Cutler Hammer magnetic starters, that automatically maintain an air pressure of 100 lbs. One is located in the north end of the machine shop, one in the center and the other in the boiler shop, two of them can supply the maximum demand, one being available in case of emergency. These receive air from the outside.

The air piping is carried overhead on the roof trusses and pipes to drops are carried down the column, piping for pits being hung in heating tunnel, which extends along the end of the pits.

SCRAP BINS.

These are located within easy reach of each stop, being planned to conform with the latest classification as compiled by the General Storekeepers' Association.

The Maintenance of Way Department

Relaying Rails

Editor, Railway Engineering:

My practice of relaying rails is thus: Distribute the rails on both sides of the track which is to be relaid, pull the spikes from the old rails on the inside, adze the ties off smooth, and lay the new rail in the track, one rail at a time, giving the necessary expansion as may be required under weather conditions. The expansion allowed is as follows:

30 degrees.....1/4 of an inch
50 degrees.....3/16 of an inch
70 degrees.....1/8 of an inch
90 degrees.....1/16 of an inch

The rail is full bolted in the track and full spiked to gauge. The old rail is disconnected, saving all the bolts that are fit for use as well as the nutlocks and angle bars. The old rail is laid alongside the track and loaded on flat cars, being sorted out, laying the good rails on side lines and the fairly good rails on sidings.

Yours truly,

Michigan. Roadmaster.

Rail Joints

Editor, Railway Engineering:

I wish to state in my 25 years' experience on track work in handling many different rail joints or rail fastenings, I find that the 40-inch 6-hole angle bar with slot holes in each end, and not in center, making a supported joint, comes as near to being a perfect joint as I have come in contact with. A supported joint resting on three ties comes as near to being a perfect joint as I have ever used. This joint, in my opinion, will last longer and will have the least effect on rail as any other fastening on the market. I don't wish to go into any further controversy stating why I think this joint is the best at this present writing. As for nutlocks, the Verona nutlock is far superior to any nutlock I have ever used in life and strength. As I don't wish to infringe on any other rail joint or rail fastening, I am just simply giving you my opinion on rail joints. Other roadmasters may differ and will differ.

Yours truly,

Illinois. Roadmaster.

Track Devices

Editor, Railway Engineering:

We have 220 miles of main line and an additional 50 miles of branches, besides passing tracks and spurs. We have done very little new work lately, but do a whole lot of repairing, especially on the branches. On the main line we are using oak ties altogether this year. We have been using Texas pine ties, although we used 15,000 spruce ties last winter. I believe the oak ties are the most serviceable ties if we could only get them first-class quality; that is, when they are composed of the body of the tree and not split. Some of our ties are split—two out of a tree and sometimes four out of one tree. The spruce tie had a good body—the whole body of the tree—and was a very suitable tie for dirt ballast. When putting in those ties we always surface our track, but where there is ballast a spruce tie (hewed, as they all are) is a difficult thing to handle properly, varying as they do from six to twelve inches in thickness, making it necessary to dig ballast down so ties will have uniform surface when in track.

Our oak ties are supposed to be 8 ft. long, 8 ins. wide and 7 ins. thick, with the whole body of the tree, consequently having 100 per cent of heart. We do not always get ties of this kind, a great many of them having only 25 per cent heart. Now comes the question of spiking those ties without splitting them. We cannot spike those ties according to our standard, that is, set spikes 2 inches from edge of tie—spikes to be set diagonally—leaving about 4 inches space between them. If we do that we will invariably split our ties, and if we set our spikes opposite each other our ties will "slew" or get diagonal with the rail very easily. We have some heavy grades on our road, in fact, there is none of it level—it is all up and down grade, and we have considerable trouble with our rails "running." Consequently, a poor tie necessitates poor spiking, which in turn refuses to hold tie in its place, allowing rails to run and eventually "buckle," and in all probability cause derailments. In addition to this, when ties become diagonal with the rail, the gauge naturally becomes tight, making it impossible to keep track in good alignment or surface, for when ties "slew" they move off their old bed and soon begin to churn and cause rough track, and later on cause "trouble,' both for the track men and the company. So you see that spiking a tie properly is a very important factor in the maintenance of good track.

We have a great many curves on our division—50 per cent of our track is curves. We take the gauge of these curves regularly every month. We have most of our curves plated—an absolute necessity—our curves varying from one to ten degrees. We intend keeping them at perfect gauge. When we find the spikes getting loose on outside of rail we pull them, plug the holes and re-spike them. Sometimes gauge will seem to be all right and rail fit up to inside spikes, while outside spikes may be an inch or more away from flange of rail, allowing rails to spread under pressure of locomotive and train.

The best method I know of is to adze ties under inside of base of rail and turn surface of ball of rail inwards. This will put an upright instead of a lateral pressure on the rail, consequently putting pressure of train on the ties instead of the spikes, as was the case

before adzing was done—this on curves mostly, of course.

We have several kinds of tie plates that are of various patterns. We have also 52, 65, 75 and 85-lb. rails. We have all 75-lb. rail on one district and 85-lb. rail on another district. There is one kind of 85-lb. tie plate with a shoulder and two spike holes on outside; it is also thicker on outside, consequently tilting rail upwards. This is a very good kind of plate. We have other plates with hooks and flanges on the base, which split the tie and allow snow and rain to lodge in those splits, and consequently cause the tie to decay before it has rendered half the service it otherwise would have done.

We use 52-lb. rail mostly on the branches and native pine ties. It is very difficult to keep track in gauge with a small rail, a soft tie, sharp curves and steep grades. We have all these conditions to contend with on this division. We only give about two inches elevation to the sharpest curves on these branches on acount of the speed of trains. These are all coal branches—that is, leading to coal mines. The maximum speed limit going to the mine (up grade) is six miles per hour, which is usually lived up to on account of sufficient tonnage. The same rate of speed holds good down grade on account of liability of train to get away and danger to life and property. Consequently, we cannot give our curves on these branches any more elevation. We use all native soil (dirt) ballast, have neither the time nor opportunity (account curtailing expenses) to clean the ditches, consequently when it rains or snows track in these cuts gets very soft, eventually very rough, making track more liable to spread. Soft and rough track are the chief causes for track spreading. Of course, we use rail braces on curves, about six on each side to the rail. We use the old-time stub switch on all these branches, so you may know with the heavy grades, light rail, etc., we have experience with "tight switches," lips on the switch, spreading rails on turnouts and several other defects that go with stub switches.

Yours truly,

Colorado. Roadmaster.

Rail Joints

Editor, Railway Engineering:

In regard to rail joints, I have had experiene with the various kinds, but have had better success with the Weber than any other joint. They have been in track 15 years and very few have broken. They are apparently as good now as when they were first laid, and have cost us nothing except the renewal of the wooden fillers once during that time, namely, when the rail was taken up from main line and re-laid on branches. Have used them with 4½-inch, 67-lb. steel, 5-inch, 75-lb. steel and 5 3/16-inch, 85-lb. steel. The length of joints is 25 inches with 4 holes, and we use ordinary bolts with nutlocks.

I think track can be kept up with less labor where these joints are used than with any other type, and rail will not batter as badly as when used with angle bars, account of the shoe under the joint. There is also less noise when train is passing over track laid with the Weber joint account of its being deadened somewhat by the wooden fillers, which is much appreciated by the patrons.

Yours truly,

Massachusetts. Roadmaster.

Rail Joints

Editor, Railway Engineering:

I have had about twenty-five years' experience in practical track work and have used fish plates, long and short angle bars, 100 per cent angle bars, and Continuous rail joints. I find that the Continuous rail joint is the best joint on the market today. I have had them in use in track with heavy traffic for past five years, and they are giving the best of satisfactory results, make the best and smoothest joint, and do not break like the common angle bar. As they have base support, they keep the point from battering. I could write more on this, but may be able to give more detailed account of joints some other time.

Yours truly,

Pennsylvania. Roadmaster.

Rail Joints

Editor, Railway Engineering:

At the present time we have in use on my division the following kind of joints, namely: Continuous joint; six hole, 29 ins. long; six hole, 29 ins. Weber joint; four hole, 24-in. Weber joint; six hole, 29-in common angle bar; four hole, 24-in. common angle. All the above are for 80-lb. rail.

I find that we obtain better alinement from the and expand, but the Continuous and Weber, after being in service for some time, become rusted to the rail and set tightly, do not allow the rail to contract and expand and thereby cause bad alinement, especially in the warm weather.

We use very few nut locks in our main track on account of using the ⅞-in. bolt with Harvey grip thread, and this gives good results.

In my opinion where ballast is good we can maintain and keep in good condition the track with the common 80-lb. angle bars and get better results than with any other at about three-fourths cost of the Weber, but for general use, and especially where ballast is bad and ties are churning, you can obtain best results with the 6 or 4-hole Weber joints and your track will keep in the best surface where ballast is poor. Our joints last from 8 to 10 years on main track, but become badly eaten from brine drippings from refrigerator cars.

Yours truly,

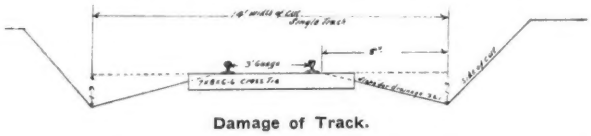
Illinois. Roadmaster.

Damage of Track

Editor, Railway Engineering:

Regarding the ditching and drainage of track, that is something I am very much interested in. I will give you a few pointers on the subject as far as my experience and judgment of track work goes for the last 30 years.

Now I am working on a small railroad some thirty miles long in a country some 900 feet above sea level and surrounded by mountains. We also have a rainy season here some six months in the year. Almost every day in that time, and especially in July and August, there are very hard rains, and that is the time it keeps a roadmaster pretty busy keeping his track well drained to avoid trouble. You will note by the rough sketch the way I keep the track drained. Most



Damage of Track.

every roadmaster has an idea of his own, and some roadmasters have not the privilege of using their ideas; as for ballast and the way it is put, that all depends on the class of rock ballast. I would fill up level with top of tie, but leave the same slope for drainage. Ballast we have here is of all classes, such as sand, gravel and earth from the cuts. By using this system of ditching and drainage of tracks I find very little churning ties. A chief engineer on one of the roads in Mexico told me personally that he believed in letting his roadmasters use their own judgment and fix up the track to suit themselves. As long as trains stayed on the track I am of the same opinion.

Yours truly,

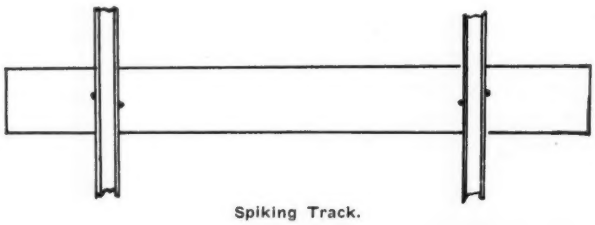
Mexico. Roadmaster.

Spiking Track

Editor, Railway Engineering:

Ten years ago, twenty years ago, yes, to my knowledge thirty years ago, we spiked as follows:

"Tack" the spikes one-half their diameter from rail, "staggering" the spikes as shown on rough sketch (in order to hold tie square across track), now drive spikes straight down and, as head of spike comes near to rail, give last tap in. This leaves spike ready for future claw bar. We use home-made plugs when respiking. As to gauge of track, 4 ft. 8½ ins. on layouts and curves of less than 5 degrees; 6 degrees and up, 4 ft. 9 ins.



Spiking Track.

I would respectfully suggest that "How to make a permanent way of our American roadbeds," or how to make our tracks safer, would be more to the needs of 1909.

Yours truly,

Minnesota. Roadmaster.

Ties and Cost Data

Editor, Railway Engineering:

I have given a great deal of thought to the subject of ties, and will endeavor to give you the results of my investigations.

I have found that the best time for the renewal of ties is as soon as the weather becomes settled in the early spring, and all the ties that are to be renewed in the year should be put in as rapidly as possible.

It has been customary on this division for the last few years not to take out of track any ties that would last for two years which would necessitate the renewal of ties left in and the surfacing of track every two years. I have found this to be a very expensive plan, as you will see from examining the lists herewith showing the cost of putting in ties and surfacing a piece of track.

By putting in ties to a face, or, in other words, putting in all new ties at the same time, the piece of track will last from four to five years, according to the class of ties used. This company does not use any but white and post oak ties, untreated, the life of which is from four or five years, under the best conditions.

When a piece of track has been mud pumping, and the ballast has become foul, it is best to clean out ballast to bottom of tie, then put in all the ties that are to be put in, thoroughly fork the ballast that has been

DAILY REPORT OF WORK DONE IN PUTTING UP NEW TRACK, DURING MONTH OF.....190

DATE	Cleaning Out Track.	Putting In Ties.	No. Put in	Ballasting	No. Cars	Cubic Yards.	Cleaning Right of Way.	Piling or Loading Old Ties.	Ditching and Banking.	Putting In Switch Ties.	REMARKS.
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
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20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											
Total											

The labor shown above was used on one piece of new track between following poles and mile posts:

Between Poles.	Between M. P.	REMARKS.

Brought to standard cross-section during the month the following number of feet of this same piece of track:

No. of Feet.	Between Poles.	Between M. P.	REMARKS.

Signed ..... Foreman.

Ties and Cost and Cost Data—Information Blank.

cleaned out, throwing back into the track the ballast so cleaned, and wasting the remainder. Frequently a sufficient amount of ballast is recovered from surfacing, and the new ballast used to fill in and shoulder. If not enough ballast is recovered for surfacing, it is necessary to unload new ballast before the surfacing can be done.

Ties should be tamped their entire length except about 18 ins. in the center, and especial attention given to the tamping of joint ties.

Whenever it is possible to do so, all new ties that are to be used should be distributed before the regular season's work commences.

I think you will be interested in the cost of new track as shown on accompanying lists, and I also send you form of blank used to get this information, which I have found in force on this division. This not only gives you the cost of each piece of new track, but also gives you the difference in the cost of track on different sections, which shows what each man is doing.

Yours truly,

Tennessee. Roadmaster.

COST OF ONE MILE OF TRACK PUT UP BY SECTION GANG.

Cleaning Out Track	$ 2.75
Putting in Ties	273.68
Ballasting	472.30
Cleaning Right of Way	70.50
Piling or Loading Old Ties	40.45
Ditching and Banking	114.44
Putting in Switch Ties	38.46
Ties	666.00
Ballast	778.00
Total	$2,456.58

COST OF LABOR ON PIECE OF TRACK SHOWN ABOVE.

Cleaning Out Track	$ 2.75
Putting in Ties	273.68
Ballasting	472.30
Total	$ 748.73

COST OF ONE MILE OF TRACK PUT UP BY FLOATING GANG.

Cleaning Out Track	$ 424.39
Putting in Ties	368.85
Ballasting	534.80
Putting in Switch Ties	18.12
Piling or Loading Old Ties	6.51
Ties	1,007.14
Ballast	471.50
Total	$2,831.81

COST OF LABOR OF PIECE OF TRACK SHOWN ABOVE.

Cleaning Out Track	$ 424.39
Putting in Ties	368.85
Ballasting	534.80
Total	$1,328.04

COST OF 5,406 FT. OF TRACK PUT UP BY SECTION GANG.

Putting in Ties	$ 291.33
Ballasting	604.41
Piling or Loading Old Ties	31.68
Ditching and Banking	126.52
Ties	1,006.40
Ballast	631.50
Total	$2,691.84

COST OF LABOR ON PIECE OF TRACK SHOWN ABOVE.

Putting in Ties	$ 291.33
Ballasting	604.41
Total	$ 895.74
Average Cost of Putting Up Mile of Track on Crushed Stone	$ 861.00
Average Cost of Putting Up Mile of Track on Gravel	584.00
Average Cost of Putting in Tie	0.101

Locomotive Repair Shops, Stratford, Ont.

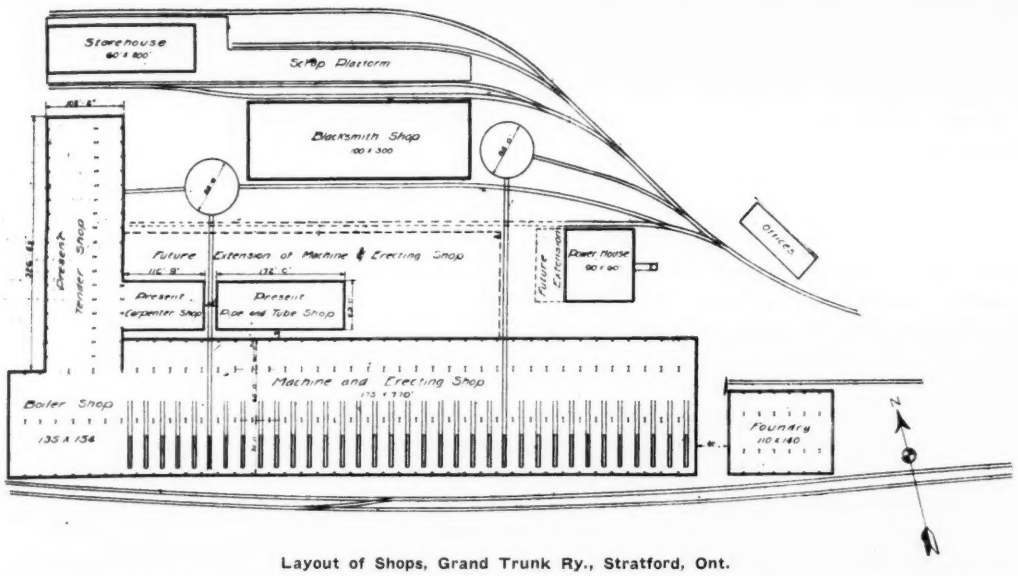
Grand Trunk Railway

The new locomotive shops of the Grand Trunk Railway System in Stratford, which include part of the shops built in 1888 and also a new tender shop built in 1904, are among the largest on the continent. They were designed by the Arnold Company of Chicago. The Forest City Paving Company of London had the contract for the cement work, and the Canadian Bridge Company of Walkerville for the steel. The portion recently completed was commenced in August, 1907, so that the construction has taken about a year and a half. The modern machinery with which the shops are equipped, was installed under the supervision of Mr. Robert Patterson, master mechanic. A description of the shops, particularly the main portion and power house, follows:

The shops of the Grand Trunk Railway System now completed in Stratford are the general locomotive shops of the middle and southern divisions, including lines west to St. Clair and Detroit rivers and extending east to Toronto, Niagara Falls, Fort Erie, and all branch lines in the province of Ontario. This division includes about 1,491 miles of road and 400 locomotives. The new shop plant consists of a machine and erecting shop, 616x175 ft., a boiler shop, 135x154 ft., and a power house, 90x108 ft. The power house and the machine and erecting shop are connected by a pipe tunnel made of reinforced concrete. In addition to these buildings there is contemplated in the future the erection of a foundry, 110x140 ft., and a pattern shop 50x120 ft. It is also proposed to run a yard crane from the foundry to the machine and erecting shop. All these various buildings, etc., are shown on the cut herewith published, which also shows the older buildings, consisting of the tender shop completed in 1904, the offices, the storehouse, blacksmith shop, carpenter shop, brass foundry, plate shed, tube and pipe shop, etc.

THE NEW LOCOMOTIVE SHOP.

This building includes both the machine and erecting shop and the boiler shop. The building is a self-supported, steel structure, with concrete walls. The total length is 770 ft. and the total width is 175 ft. There is no division between the machine and erecting shop and the boiler shop, the same runaways being



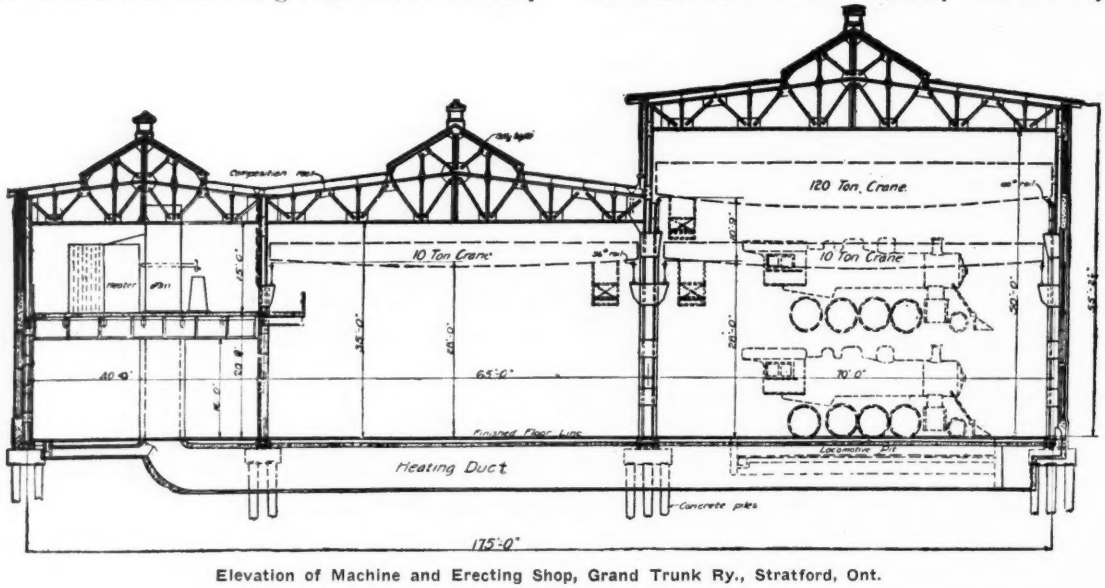
Layout of Shops, Grand Trunk Ry., Stratford, Ont.

carried through both shops. The erecting and machine shop is 616 ft. in length and contains 28 engine pits, 22-ft. centers. The locomotives enter the building on the north side from an 85-ft. turntable to engine pits. The engine pits are provided with air, water, and electrical connections for lighting and running small machines, such as cylinder-boring machines, etc. Jib cranes are mounted on south columns and occur midway between engine pits. These are to be used for the lighter parts of the locomotives during dismantling and erection. There are small jib cranes on center columns on the north side of the machine bay to assist in hauling material in connection with machine work independent of overhead electric cranes. The erecting shop is served with a 120-ton crane capable of lifting the heaviest locomotives to a height sufficient to clear the other locomotives on the floor, carrying same to any part of the shop desired. The interior view of the erecting shop illustrates the method of handling locomotives. Directly below the 120-ton crane is a messenger crane of 10-ton capacity for handling the various parts of the locomotives such as drivers, trucks, engine frames, etc., which are not heavy enough to warrant using the 120-ton crane.

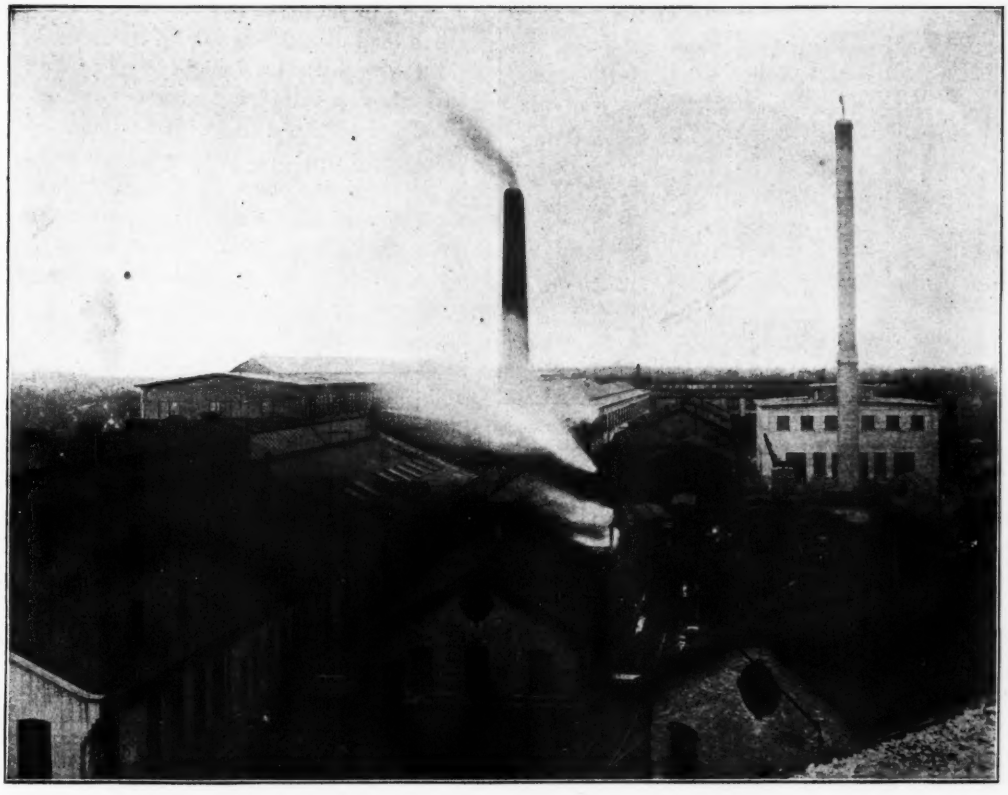
THE MACHINE SHOP.

Paralleling the erecting shop is the machine shop, in two aisles, one with crane service for large machines and one without crane service, containing small belt-driven tools. Above the latter is a gallery used for heating fans, air brake department, brass work, bolt work, and other light machine work. All heavy machines in the center bay of machine shop are driven with individual motors, but machines under and above the balcony are divided into nine groups. Each one can be run separately or a number can be coupled up and driven together. As the work of this shop is all specialized, each group contains its own particular machines for its special work, also the necessary fitting equipment.

Alternate columns of the heavy machine bay are



Elevation of Machine and Erecting Shop, Grand Trunk Ry., Stratford, Ont.



View of Locomotive Repair Shops, Stratford, Ont.

provided with compressed air and electrical connections. Air is also provided along north wall of building and under balcony. On each fourth column of the two middle rows of columns, water service connections are provided on the main floor and balcony.

THE BOILER SHOP.

The boiler shop is located on the west end of the machine and erecting shop, and is provided with stalls located on 22-ft. centers. The shop is composed of two bays, one 70 ft. wide and the other 65 ft. wide. The 70-ft. bay is served with a 30-ton crane, which crane runs upon a continuation of the 120-ton crane runway of the erecting shop. This is also served with a 10-ton messenger crane running below the 30-ton crane. The 65-ft. bay is provided with a 10-ton crane. No riveting tower has been provided in the present designs and if same is required in the future, an extra half bay will be built on the west end of the boiler shop, to the necessary height. This will be supplied with a 20-ton crane for lifting boilers, also with a hydraulic riveting stake. The boiler shop is further provided with flange and plate furnaces, which furnaces connect with flues in the west wall of the boiler shop. These flues are built inside pilasters of the building, being in cross-sectional area, 18x24 ins., with walls 8 ins. thick extending a short distance above the roof line. Four such chimneys are provided in the west end of the boiler shop. The boiler shop is also provided with two test pits, 24 ft. long and 4 ft. wide, for testing boilers. These are located in the southwest corner of the building, adjacent to the flange furnaces.

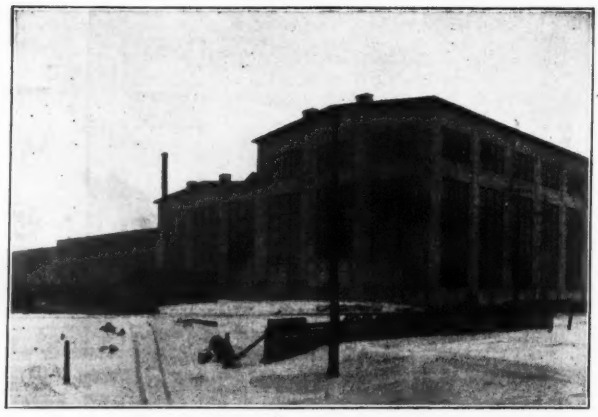
HEATING.

The entire building is heated by indirect radiation, utilizing exhaust steam from the power house in heaters. It may be necessary at times to assist the supply of exhaust steam by turning live steam to the heaters through a reducing valve. Fans are operated by small horizontal engines, the exhaust steam from which passes into the heating coils as an additional assistance to that supplied from power house. The experience up to the present time is that this system will provide ample heating requirements for the cold weather. The circulation of air throughout the shop is very good, keeping at the same temperature for the most part. The air is taken in from the outside by means of fans, driven by small horizontal engines, exhaust steam of which passes into heat coils. Fans, heaters and engines are located on the balcony, the hot air being distributed through a system of underground concrete ducts with openings in walls and in the ends of locomotive pits on the south side of building. A small heating duct is also provided under the balcony and underground on the north side of the building, having vertical outlets through the floor.

All wiring is concealed in ducts underneath the floor. Particularly good lighting is obtained by means of large windows and from skylights which are placed in all three bays of the building.

FOUNDATIONS.

The question of foundations required some study.



View of Machine and Erecting Shops, Stratford, Ont.

The present shop plant is built upon a fill, varying in depth from 10 to 15 ft., below final floor level. After some consideration and comparison of various designs, it was decided to use concrete piles for the seven bents of the boiler shop and the west eight bents of the machine and erecting shop. These piles are driven in groups of from three to six each under the building columns. They were finished off about four feet below the floor level, at which point a reinforced concrete cap was built up to an elevation 2 ft. below floor line, which elevation was adopted for the base of steel columns. The wall foundations were carried between these concrete pile footings and were reinforced so as to act as concrete beams. The concrete piles ordinarily carry a load of from 15 to 20 tons each, maximum load, with all cranes fully loaded and full snow load on roof, between 35 and 40 tons on each pile. A test was made of one of these foundations and the same was found to be satisfactory under the above loads. The longest pile driven in was 20 ft., others varied in length down to 12 ft. The remainder of the foundations were designed with spread footings on basis of a soil pressure of 5,000 lbs. per sq. ft. These footings are carried down to the natural ground level and the wall footings are carried between them as concrete beams as previously mentioned. In the first eight bents of the machine and erecting shop, the engine pits are also supported on concrete piles, eight concrete piles being driven under each engine pit, each figured to carry a maximum load of 35 tons.

STRUCTURAL STEEL WORK.

The structural steel work consists of plate, angle and channel columns supporting roof trusses of the Warren type and plate crane girders. The steel columns are designed to carry the maximum roof, wall and crane loads with a fibre stress of 16,000 lbs. per sq. in. less the ordinary deductions for designing long columns. When crane thrusts and wind stresses are considered in addition, the total stresses are allowed to run up to 20,000 lbs. per sq. in. In designing crane runway girders, careful cossideration was given to the effect of the horizontal and vertical shear on the top flange rivets, due to heavy wheel concentration. The balcony in the light machine bay is designed to carry a live load of 350 lbs. per sq. ft. The building is provided with a copper skylight supplied with ¼-in. ribbed wire glass. A sufficient number of lockers are provided for each workman in the shop, designed on the basis of 18 workmen per engine pit. One wash basin is provided for every four men. These lockers and wash basins are located in lavatory rooms directly under the heating fans. These rooms consist of two floors, 10-ft. ceilings. This arrangement makes the lavatories and lockers easily accessible from both the main floor and the balcony, stairs being provided immediately adjacent to these rooms, extending from the main floor to the balcony.

WATER SUPPLY.

The water supply for this department is taken from a lake adjacent to the city of Stratford. In case of this supply being insufficient to meet requirements, provision is made for using the city supply. The drinking water is taken from artesian wells located on the shop site. The water service lines loop all buildings where possible, to provide a proper circulation in all parts of the system. The fire hydrants are located in different parts of the shop. Additional fire protection is already provided by the city fire hydrants, which are located close to the shops.

SEWER SYSTEM.

The shop plant is at present served by a sanitary sewer, which handles the drainage from water closets, wash basins, engine pits, etc. The system connects with the city septic tanks and contact beds, which are located about three miles from the shop site, near to the southwest of the city. The new shop is also provided with a storm water system, which will collect the yard drainage and roof drainage. This outside sewer is of vitrified tile to a point 4 ft. outside the building line, where it is joined by cast iron soil pipe inside the buildings. The storm water system discharges into a small creek to the west of the shop plant.

POWER HOUSE.

This building is a self-supported steel structure, reinforced with concrete walls, 90x108 ft. All walls and

Interior of Machine Shop, Stratford, Ont.

Interior View of Erecting Shop, Stratford, Ont.

foundations below the ground have been water-proofed. The water room is equipped with four vertical water tube boilers, traveling link grate stokers, and coal and ash handling plant. The engine room is equipped with two 400-kw. generators, direct connected to a horizontal tandem compound, and two small 35-kw. generators direct connected to simple engines; the latter being for lighting purposes. One cross-compound Corliss air compressor with a capacity of 1,150 cu. ft. of free air per minute is also installed. In the pump room there are two horizontal outside plunger feed pumps, two vacuum pumps and one fire and service pump and feed-water heater.

BLACKSMITH SHOP.

The original blacksmith shop has been retained, additions having been put to it in 1904, and it is an up-to-date shop.

TENDER SHOP.

The tender shop was also built in 1904 and is a self-supported steel structure, reinforced with concrete walls, and has a capacity for holding 18 tenders at one time for repairs. This is served by an electric crane of 25 tons capacity.

The electric power for shops is direct current, 220 volts. The shops throughout are lighted with Cooper Hewitt mercury vapor lamps. In addition to the shops, all the buildings on the company's property are lighted from the power house, including the Y. M. C. A., station, freight shed and roundhouse.

Ties Purchased by Railroads

During the year 1908, the steam and electric railroads of the United States purchased more than 112,000,000 cross-ties, costing, at the point of purchase, over $56,000,000, an average of fifty cents per tie, according to statistics just made public by the Bureau of the Census in co-operation with the United States Forest Service. This was some 40,000,000 ties less than the quantity purchased in 1907, when the total was approximately 153,700,000, the highest ever recorded. The decreased purchases in 1908 were, of course, chiefly due to the business depression which affected every line of industry. This forced most of the roads to purchase only the ties which were absolutely essential for renewals, and heavily cut down the purchase for new track. In 1908 only 7,431,000 cross-ties were reported as purchased for new track as against 23,557,000 in 1907. Of the total number of ties purchased for all purposes, the steam roads took approximately 94 per cent, leaving about 6 per cent for the electric roads.

It is very interesting to note the wide range of woods used for cross-ties. The preliminary report by the Census Bureau lists separately fifteen classes or species. Of these the oaks are now and have always been by far the most important. The oak ties amounted to more than 48,000,000, or 43 per cent of the total quantity purchased. Next to these ranked the southern yellow pines, with 21,500,000, or 19 per cent of the total. It will be seen that the oaks and southern pines combined furnished nearly three-fourths of all the ties bought by the railroad companies last year. Cedar and chestnut supplied more than 8,000,000 ties each, and Douglas fir nearly as much. About 4,000,000 tamarack ties were purchased, nearly 3,500,000 cypress ties, and, in round numbers, 3,000,000 each of western pine and hemlock. Redwood, white pine, lodgepole pine, gum, beech, spruce and several other woods were used in smaller quantities.

While the oaks, and particularly the white oaks, have always been the preferred woods for cross-ties and still form a large proportion of the total, the increasing prices which the roads have had to pay for satisfactory oak ties are forcing them to look more and more for substitutes. This accounts in part for the great variety of woods reported. White oak, untreated, makes a tie which gives excellent service for many years, but it has been found possible to take woods which naturally are not durable, give them a treatment with either creosote or zinc chloride, which will prevent decay, and thus get much longer service from them than can be secured from untreated oak ties. Among the woods which have been most largely treated so far are the yellow pines, particularly loblolly pine, Douglas fir, western pine, and lodgepole pine.

This year's statistics adds to the list two kinds of cross-ties which previously had not been reported in sufficient quantity to justify listing them separately. These are gum and beech. The purchases of gum ties in 1908 exceeded 260,000, while but slightly more than 15,000 of them were reported in the previous year. Of beech ties, the purchases in 1908 amounted to nearly 193,000, against but little more than 51,000 in 1907. These are woods which are distinctly not suitable for cross-ties unless they are given preservative treatment. Their increased use, therefore, is one of the many results of the progress of wood preservation in the United States. For many years beech has been one of the principal cross-tie woods in Europe, where its value when given chemical treatment was long ago recognized.

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and Maintenance of Way

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Co-operative Work

Before the members of the Richmond Railroad Club, Mr. H. O. Williams gave a talk on welfare work of American railways, referring particularly to the Railroad Young Men's Christian Association. Regarding welfare work he emphasized the support which the railroad corporations gave in the construction of various buildings for use of the employees. These associations are supported in part by the employees and in part by the managers but are directed entirely by the employees.

The first association was organized in Cleveland, Ohio, 1872, and at the present time the membership of the 245 associations is 90,000. These associations have the financial endorsement and assistance of railroads controlling 85 per cent of the mileage of North America. The associations own 178 buildings valued at about $3,600,000. In regard to the location of these associations he made the following statement: "On the New York Central Lines there are 40 associations; on the Pennsylvania Lines, East and West, 36; on the Grand Trunk Railroad, 14; on the Baltimore & Ohio, 9; on the Norfolk & Western, 8; and the Gould Lines count 27 amongst its valuable items of successful operating features. One or more branches are on as many as 63 different railroad lines throughout the United States and Canada."

After the address Mr. Williams read numerous letters from presidents of the larger railroad companies, endorsing the work of these railroad associations.

Signaling Report

In a recent issue of the Journal of the Railway Signal Association, an early report on signaling is printed. This report was presented to the General Railroad Convention, held in New York on October 24, 1866, and was signed by Ashbel Welch, chairman. In places of extreme danger, the recommendation was that safety signals alone should be used without danger signals which engineers might look for.

"Of course, there are many things which the engineer must presume to be right until he hears or sees them to be wrong; such as the general continuity of the track, the safety of permanent bridges, etc. Other things, such as drawbridges, etc., are so liable to be wrong, and the disaster—if they are wrong—so serious, that they should always be presumed to be wrong till they are proved to be right. What things should be presumed to be right, and what wrong, will depend upon the degree of risk, and the circumstances of different roads."

In regard to the location of signals it was advised that they should be at known and conspicuous points where these signals would always be looked for. As an example, it was stated: "If the track is disturbed, notice should be given at a telegraph station, or other point, where it will be looked for, as well as near the spot."

Then as to the simplicity of signals and the colors to be used, the following recommendations were made:

"Signals should be simple, and not repeated. An engineer, going forty miles an hour, can attend to and understand one signal, while he might be confused by two.

"Colors should be used which can be seen farthest: that is, red and white; and these combined in such well-known forms, that they cannot be mistaken for any other object of the same colors seen in the same direction."

Another question, which was discussed recently in a railroad convention, referred to conductor's and engineer's watches. The following reference was made thereto:

"The clocks at all railroad stations should be set daily, or at least frequently, by telegraph, from the standard clock. They should not be unnecessarily multiplied, for fear that some may be left wrong, and so mislead. It is a good plan, for watches, carried by each conductor and engineer, to belong to the company, and be delivered to a time clerk on arrival at each end of the route, to be set right by him, and received from him at departure, and compared with the clock both by him and the person carrying it. Allowance of a minute or two, or more, should be made for error in time, before a train should run on the

time of another which has lost its right. As far as practicable, connected roads should use the same time."

One Railroad Situation

It has been some months ago that Honorable Geo. W. Ross, ex-Prime Minister of Ontario, member of Senate of Canada, delivered an address before the members of the American Railway Engineering and Maintenance of Way Association on the subject of "Railways and International Fellowship." In his talk he emphasized the friendly relations which now exist between Canada and the United States, calling attention to the fact that Canadian roads run through American territory and on the other hand several American roads, including the Michigan Central, Wabash and Pere Marquette, traverse Canadian territory. This also serves to establish and maintain a bond of fellowship between the two countries.

Regarding the settlement of the United States and Canada, he referred to the wide influence of the railroads, mentioning briefly the progress of the settlement in our country in connection with the extension of our railroads throughout the west. At the same time railroads established intercommunication between states and thus made the country one people instead of settlements such as in the Colonial days.

Reference was also made to railroad construction in other countries and its effect upon the strength of the government. One example cited is that of the Trans-Siberian Railroad, which was no doubt of great value to the Russian government. After reviewing several situations, such as the above, he said that in that sense the railroad engineers were nation builders as they fastened the bonds between all communities.

Forest Conservation

The presidents of the leading railroads of the country have just received a letter from Gifford Pinchot, United States Forester, calling upon them to practice forest conservation and better timber utilization. In his letter the Foreser says:

"I am writing to call your attention again to some phases of a subject to which I know you must already have given much thought—the conservation of our forests. The report of the National Conservation Commission shows that we are cutting our forests three times faster than they are growing; that much large timber and young growth are destroyed yearly by fire; that as a nation we have used wood wastefully and extravagantly; that the only way we can get the timber we shall need in the future is to keep all our forest land constantly growing trees; and that the longer we delay action the greater will be the pinch of a timber shortage later on.

"One-fifth of our remaining timber is in public forests, and on these forests the nation and the states are practicing forestry. Four-fifths of our timber is privately owned, and it is being cut almost exclusively for present profit without regard to the future. The problem of providing a timber supply can not be solved by the National Government alone, by the states alone, nor by individuals alone; all must work together.

"Since the railroads are among the largest consumers of wood, they will suffer heavily from the much higher prices and the actual scarcity of timber which will occur if our forests are not conserved. Railroad companies can most advantageously undertake both the growing of timber and the economical utilization of the product. They have a steady demand for timber, the extent of which can be largely anticipated, and they need much smaller timber of kinds which can be grown in a relatively short time.

"Each railroad has its own especial timber problems which must be worked out to meet the given conditions. At the same time there are certain lines of general policy which can be profitably adopted by many roads. They are:

"1. The use of chemically treated ties wherever possible.

"2. The use of so-called inferior woods, as, for example, black gum and loblolly pine, for ties, which will reduce the drain on white oak, and which is entirely practicable if the ties are treated.

"3. The purchase and management of land bearing mature timber which can be used immediately, and of second-growth timber which will meet the needs of the future. Such lands if properly managed will insure a perpetual supply of ties and lumber at the cost of production.

"4. The planting of trees upon non-agricultural land owned by the company, which does not now contain sufficient young growth to produce a timber crop.

"5. Co-operation with other roads in the adoption of standard specifications for ties and timber and for the treatment of them. Co-operation with timber land owners and the states in fire prevention, and in bringing about conditions which will make the practice of forestry profitable.

"These are in substance the recommendations of the sub-committee on Forest Supplies of the American Railway Engineering and Maintenance of Way Association. The adoption of these recommendations and the appointment of techical men to carry them out will, it seems to me, be wise action for any railroad. The influence of their general adoption would be far reaching and most beneficial.

"I should be very glad to discuss the matter more in detail with you at your convenience, or to be of use in any other way."

Responses which show much interest are being received, and it is presumed that definite action along the lines mentioned will result.

National Irrigation Congress

Regarding the importance of the work of the National Irrigation Congress, which will have its 17th session in Spokane, August 9 to 14, Mr. R. Insinger, Chairman of the Board of Control, says:

"The National reclamation act was passed in 1902. At that time there were in the government's name, in the 16 states affected, 600,000,000 acres of arid land, of which it was estimated possible to reclaim sufficient to support 50,000,000 people. By 1911 the Reclamation Service will have reclaimed nearly 2,000,000 acres, at an estimated cost of $70,000,000. There are 40,000,000 acres of arid lands susceptible to reclamation by irrigation. The construction cost of the reclamation work is returned to the government from the sale of land, the proceeds to be again used in furthering irrigation development. Irrigation is making a garden spot and an empire of the 'Great American Desert,' and the work of the irrigation congress is yet in its infancy."

George E. Barstow, of Barstow, Texas, is president of the congress; B. A. Fowler, Phoenix, Ariz., secretary; R. Insinger, of Spokane, chairman of the board of control, and Arthur Hooker, Spokane, secretary of the board of control.

Trade Notes

Screw Spikes is the title of a most interesting pamphlet, recently issued by the Spencer Otis ompany, Railway Exchange, Chicago. You should write for a copy.

Gasoline Driven Locomotives is the title of a pamphlet issued by the Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.

Buckeye Jacks are described in a pamphlet by the Buckeye Mfg. Co., Louisville, Ohio.

Westinghouse electric motors for the office, store and shop are illustrated and described in a pamphlet issued by the Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

The Proper Care of Belts—This is a new booklet of 24 pages, recently gotten up by the Joseph Dixon Crucible Company, Jersey City, N. J. It is divided into three sections, headed respectively: Belts, Belt Dressings; and Hints, Kinks, Tables. The first section deals with the running condition of belts; the second takes up treatment with various preparations; and the third, as the title indicates, has some general points upon belting and its use. This last section contains a considerable amount of interesting and valuable matter collected from many authoritive sources. It tells what results were secured in a plant where records were kept over a period of years; gives the economical speeds at which leather belts should be run; has some matter telling of the different styles of joints, illustrating three methods of leather lacing; contains rules for calculating speed of pulleys; gives horse power transmitted by various sizes of single and double belts, etc. Any one who has any amount of belting under his care should have a copy of this booklet. While it is gotten out in the interests of the Traction and Solid Belt Dressings that the Dixon Company place on the market, it contains so much matter of general interest as to be valuable to the practical man. Those desiring a copy of this booklet may secure same by writing direct to the home office of the Joseph Dixon Crucible Company, at Jersey City, and mentioning this publication.

The Detroit United Railways recently placed a contract with the Westinghouse Machine Company for another turbine unit. This company already operates Westinghouse turbines in three of its power stations—the central station in Detroit, the Baltimore Station of the Detroit and Port Huron Railway and the Munroe station of the Detroit and Munroe Railway. The new turbine, which is 1000 kilowatts capacity and which is to operate at 150 lbs. steam, 28 inches vacuum and saturated steam, will be installed at the Rochester station on the Detroit & Flint division. This station already contains engine type units but extensions of traffic have necessitated the installation of this new turbine unit. The Flint division is about 62 miles in length with central station at Rochester and substations at intervening points and operates heavy, high speed interurban cars, reaching the center of Detroit over the city lines. The system is operated by high tension alternating current transmission, originally supplied through inverted rotaries, but with the installation of the new unit direct, direct from the turbo generator. The direct current equipment will then be used for feeding directly into local sections of the distributing system while the alternating current machine will carry the outlying portions of the line load.

Technical Publications

THE RAILWAY LOCOMOTIVE, by Vaughan Pendred, M. Inst. Mech. E. M. I. & S. Inst. Published by D. Van Nostrand Company, New York. Cloth binding, 306 pages, 5x8 ins., illustrated. Price, $2.00 net.

The book is divided into three sections, which are as follows: Section 1, the locomotive engine as a vehicle; section 2, the locomotive as a steam generator, and section 3, the locomotive as a steam engine.

This volume is written neither as a technical treatise nor a popular one, but it is intended to describe the modern locomotive and its parts and to explain "why it is what it is."

RAILROAD STRUCTURE AND ESTIMATES, by J. W. Orrock, C. E. Published by John Wiley & Sons, New York. Cloth binding, 270 pages, 6x9 ins., illustrated. Price, $3.00 net.

"Under the title of Railroad Structures and Estimates the intention is to cover in brief and concise form the numerous subjects that enter into the Engineer's Estimates of Railroad Building, for the purpose of ready reference, as to general construction and cost, on a business rather than a technical basis.

"As it is impossible to give data to suit all conditions, the weights, quantities, and cost are given in detail in most instances, and may be varied as desired."

The book is very satisfactory for the purpose for which it was written. The nine chapters headings are as follows: Track Material; Fences, Gates, Sign Posts, Road Crossings and Guards; Culverts; Bridges; Buildings; Water Stations; Shops; Specifications and Contracts, and Estimating Notes.

GENERAL LECTURES ON ELECTRICAL ENGINEERING, by Charles Proteus Steinmetz, A. M., Ph. D. Edited by J. L. Hayden. Published by Robson & Adee, Schenectady, N. Y. Cloth binding, 284 pages, 6x9 ins., illustrated. Price, $2.00.

"This book contains a series of lectures delivered by Professor Charles Protens Steinmetz, under the auspices of Union University, in the winter of 1907-08, to a class of younger engineers, consisting mainly of college graduates. The subjects were treated in such a simple and intelligible manner, than when editing the lectures, it was found possible to avoid the use of mathematics altogether, and so make the lectures equally available to that large class of engineers, who do not care for mathematics, or are not familiar with them, without in any way decreasing their value for the college trained engineer.

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The next three lectures deal with distribution, then three on long distance transmission, one with generation and three with operation. There are also lectures on the use of electric power, on railroading and on electrochoemistry.

RAILWAY ENGINEERING

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